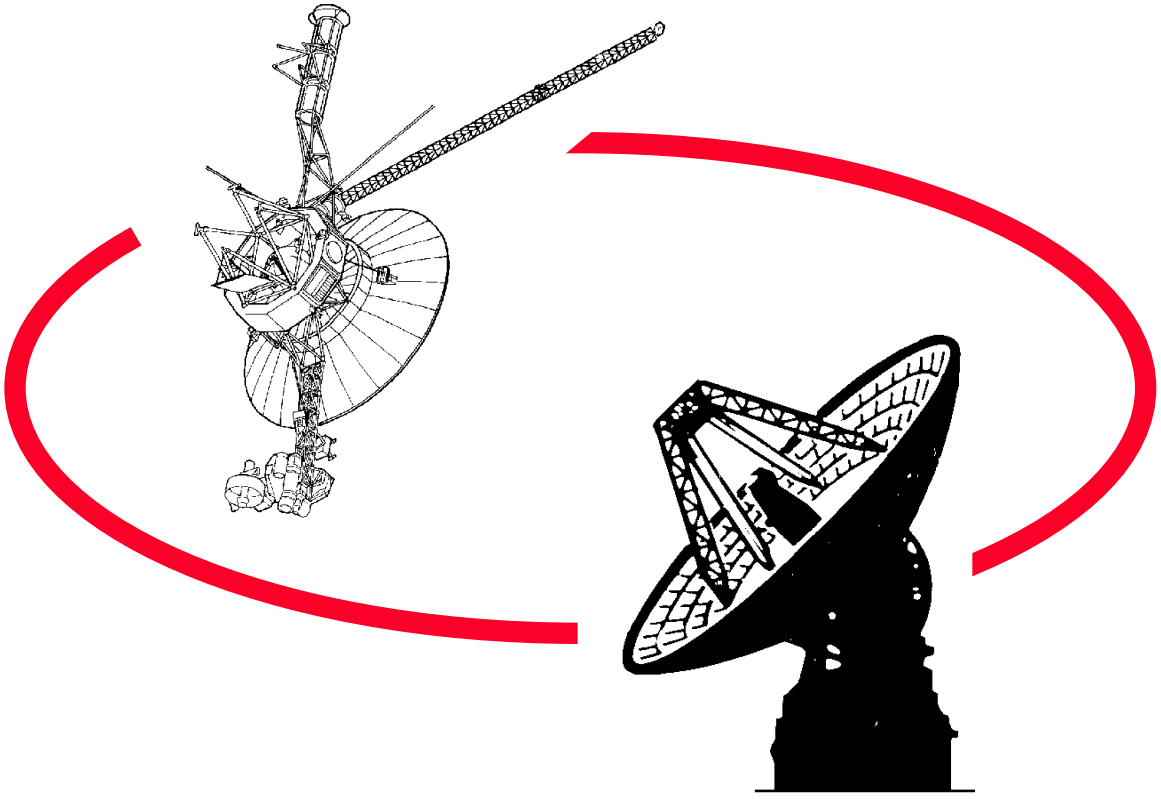
JET PROPULSION LABORATORY

Telecommunications and Mission Operations Directorate

"Bridging the Space Frontier"



FY98 IMPLEMENTATION PLAN

January 30, 1998

This Implementation Plan describes the mission, goals and strategies for guiding the activities of the Telecommunications and Mission Operations Directorate (TMOD). The plan supports *The JPL Implementation Plan, Fiscal Year 1998* (JPL 400-549), published October 1, 1997 and, by extension, the higher level NASA and U.S. Government documents listed in the references.

Today a global economic contest has replaced the Cold War as the motivating force behind national investments. Success in this paradigm requires prestige, technology and cost-effectiveness. These are achieved by doing hard-to-do, never-done-before kinds of things, and doing them within stated costs. Because space exploration enhances national prestige and drives technology it continues to be on the nation's investment agenda, as manifested by NASA, its field centers and JPL.

From the earliest years of our nation's space program until now, the people of JPL have carried out these responsibilities in an exemplary manner. By doing so they have generated a tremendous expansion in technology and scientific knowledge that has truly changed the ways we live and altered our view of the universe.

NASA's 1998 Strategic Plan (NPD-1000.1) specifies the agency's near-, mid-, and long-term goals: (1998-2002) establish a presence, (2003-2009) expand our horizons, and (2010-2023) develop the frontiers. The NASA goals are to culminate in, among other things: the creation of a virtual presence throughout our solar system; a deeper probing of the mysteries of the universe and life on Earth and beyond; the conduct of human and robotic missions to planets and other bodies in our solar system to enable human expansion, and; the creation of an international capability to forecast and assess the health of the Earth system.

The challenges of the future are as daunting as those of the past and the potential rewards are as great or greater. It is the nature of planning that the near-term will always be clouded with uncertainty whereas the long-term vision may perhaps be described with more clarity. No one should understate the turbulence of the current times or even guarantee that this will soon change. One intent here is to describe our longer range vision so that we can keep the goal in sight despite the pressures of intervening events. Thus we will be able to work in the near-term with a clear idea of how our efforts will contribute to that long range vision.

In the foreseeable future the world will witness technological advances that will dwarf those of the past. Before long our culture will embrace an understanding of the universe that includes, among other things, its origins, evolution and destiny, the distribution and character of planets around other stars, and the occurrence or prevalence of life in those environments. I fully expect the people of TMOD to be among the leaders and innovators who will make these things happen.

_____

Gael F. Squibb
Director
Telecommunications and Mission Operations Directorate

TMOD Mission

Provide space communications and operations systems that define the state-of-the-art, span the solar system, and service NASA's space exploration fleet.

JPL's Telecommunications and Mission Operations Directorate (TMOD) provides NASA's deep space flight projects with the data and mission services they need to successfully achieve their objectives, as specified by the Space Science Enterprise. The program is charged with four programmatic areas of responsibility:

(1) Provide telecommunications for successful execution of a broad spectrum of space exploration missions.

(2) Provide mission operations that contribute unique skills to the conduct of space exploration missions.

(3) Conduct ground-based radio astronomy, solar system radar, and radio science observations.

(4) Manage and operate flight projects assigned to the Directorate, specifically Galileo, Ulysses, Voyager, Space VLBI and Cassini.

Additionally, an expanding future role, supporting the piloted Mars missions of the Human Exploration and Development of Space Enterprise, is envisioned.

In carrying out these responsibilities, the Directorate is expected to advance the state of the art, as enabled by the skills of its workforce and the state of its facilities. Accordingly, it plans and develops advanced telecommunications and operations technologies.

Planning Environment

The environment in which TMOD must plan is characterized by three fundamental trends: increasing demand for telecommunication and mission operation services and technology advancements; highly constrained resources, and; organizational change.

Increasing Demand for Services and Technology

As alluded to in the introduction, NASA's post-cold war activities are driven less by national security interests and more by a desire to advance the science and technology needed to enrich our quality of life. Formalizing this change, the White House's September 1996 National Space Policy states:

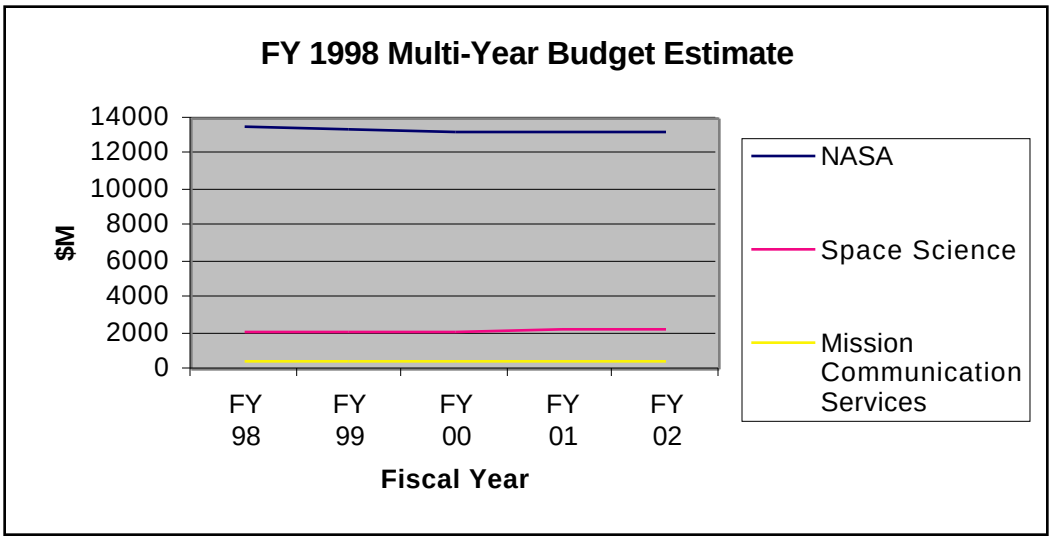
> NASA, in coordination with other departments and agencies as appropriate, will focus its research and development efforts in: space science to enhance knowledge of the solar system, the universe, and fundamental natural and physical sciences; Earth observation to better understand global change and the effect of natural and human influences on the environment; human space flight to conduct scientific, commercial, and exploration activities; and space technologies and applications to develop new technologies in support of U.S. Government needs and our economic competitiveness.
>
> To enable these activities, NASA will [among other things]:
>
> Continue a strong commitment to space science and Earth science programs. NASA will undertake:
>
> (i) a sustained program to support a robotic presence on the surface of Mars by year 2000 for the purposes of scientific research, exploration and technology development;
>
> (ii) a long-term program, using innovative new technologies, to obtain in-situ measurements and sample returns from the celestial bodies in the solar system;
>
> (iii) a long-term program to identify and characterize the planetary bodies in orbit around other stars;
>
> (iv) a program of long-term observation, research, and analysis of the Earth's land, oceans, atmosphere and their interactions, including continual measurements from the Earth Observing System by 1998.
>
> In carrying out these activities, NASA will develop new and innovative space technologies and smaller more capable spacecraft to improve the performance and lower the cost of future space missions.

Consistent with these statements, NASA's 1998 Strategic Plan (NPD-1000.1) specifies the agency's near-, mid-, and long-term goals: (1998-2002) establish a presence, (2003-2009) expand our horizons, and (2010-2023) develop the frontiers. The NASA goals are to culminate in, among other things: the creation of a virtual presence throughout our solar system; a deeper probing of the mysteries of the universe and life on Earth and beyond; the conduct of human and robotic missions to planets and other bodies in our solar system to enable human expansion, and; the creation of an international capability to forecast and assess the health of the Earth system. Commensurate with these goals, the Space Operations Management Office (SOMO), in its Space Operations Implementation Plan, projects that the Space Science Enterprise (Code S) will require support for 86 missions through 2004. Similarly, Mission to Planet Earth (Code Y) will need support for roughly 34 missions while the Human Exploration and Development of Space [HEDS] (Code M) will

require support for 18 non-Shuttle missions through 2004. A significant portion of these missions will require TMOD support; and, with more complex investigations and associated instruments characterizing these missions, the associated data and mission services needs are expected to increase dramatically over the next several years. In FY98 alone, NASA anticipates that the Deep Space Network (DSN) will service 45 missions for a total of 92,000 hours – a 26% increase over the 73,000 hours of service being provided just two years ago. These missions comprise not only the deep space set but, also, a large number of Earth-orbiters and missions for which the DSN provides launch and early orbit phase support.

Highly Constrained Resources

With growing concern over the growth in the national debt, Congress and the current Administration have been working to increase the efficiency and reduce the cost of Government operations. Over the past two years, the NASA Administrator has worked with these entities to arrive at a five-year budget for NASA that contributes to these goals while ensuring stable funding in future years. The result of these efforts, the NASA FY98 multi-year budget estimate, shows a relatively flat budget through 2002 for NASA as a whole, the Space Science Enterprise, and Mission Communication Services. Given these relatively flat budget projections through 2002, the TMOD budget will likely remain flat as well.



Reductions in TMOD's JPL/Caltech workforce are also projected through 2000. These are driven primarily by the political decision to reduce the size of government. The intent is to contract with industry for routine activities to the greatest extent practicable, while retaining only those development and operations functions that contribute to JPL's core competencies in deep space systems.

Finally, foreign agencies have recently shown an increased interest in providing TMOD-like services. Future partnerships with these organizations may lead to an increased ability to meet the expected demand for services while remaining within the anticipated budget and workforce ceilings.

Organizational Change

In keeping with the Administration's desire to increase the efficiency and reduce the cost of Government operations, it directed NASA, in its September 1996 National Space Policy, to "Seek to privatize or commercialize its space communications operations no later than 2005." It also directed NASA to "Examine with DoD, NOAA and other appropriate federal agencies, the feasibility of consolidating ground facilities and data communications systems that cannot otherwise be provided by the private sector." The NASA Administrator began addressing this direction by consolidating the management of NASA's space operations under the Space Operations Management Office at Johnson Space Center. As described in SOMO's Space Operations Implementation Plan, it "has implementation responsibility as the service provider for NASA's space operations and provides agency management for the associated space operations work process. The NASA centers, in support of their respective center implementation plans for space operations, are responsible for the execution of the space operations work process." Through this cooperative arrangement with SOMO, TMOD oversees operation of the Advanced Multimission Operations System (AMMOS) and the Deep Space Network (DSN). Under SOMO's leadership, efforts are underway to consolidate and streamline major support contract services. In FY98, a transition will occur to a Consolidated Space Operations Contract (CSOC), with a single cost-plus-award-fee, ten-year contract.

Consistent with these developments, TMOD has been working to understand its role in partnering with the CSOC contractor as well as other agencies and foreign entities. TMOD has also been examining its functional activities to identify any which might be amenable to immediate commercialization.

Another significant trend is the emerging interdependence of JPL's Directorates. TMOD is working closely with the Space and Earth Sciences Directorate (SESPD) and Mars Exploration Directorate (MED) to better understand their service needs. Recent senior management decisions will lead to an expansion of the roles TMOD fulfills for these Directorates. TMOD will assume responsibility for development of mission operations systems and actual flight operations for most - eventually all - of their flight projects. TMOD is also assuming a leadership role in the definition, development and eventually procurement of planetary communications relay systems. Finally, TMOD is working with the Technology and Applications Program Directorate (TAP) to construct a coordinated technology program that will enable future projects to have access to the latest technological advances in space communications and mission operations.

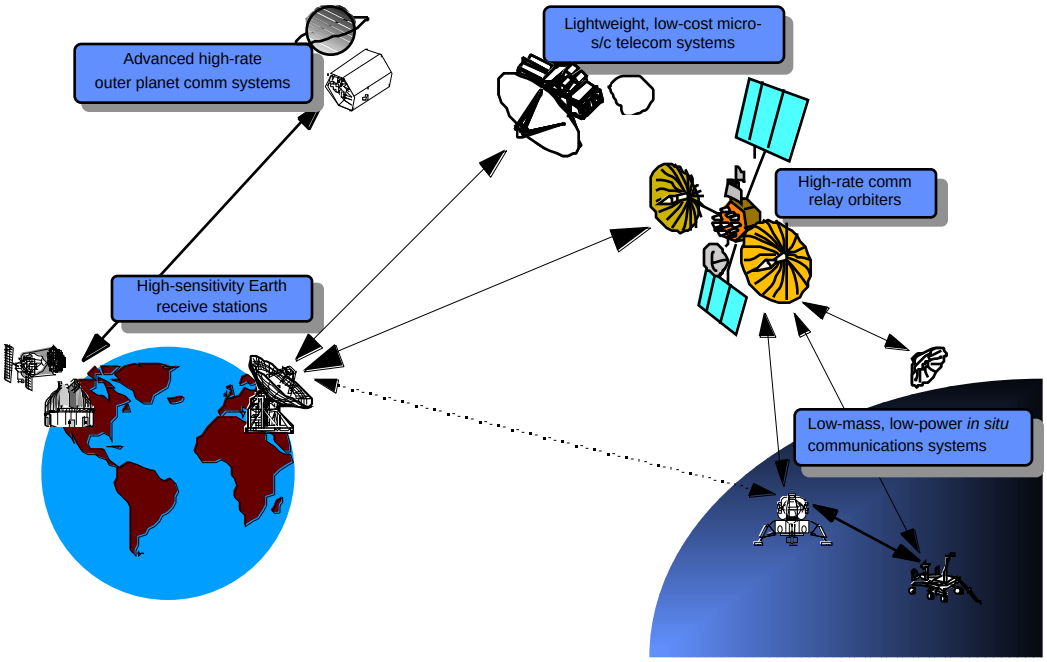
Mission System Design

In the past, the evolving designs of the Deep Space Network and the Advanced Multi-Mission Operations System were largely determined by the specific needs of the current large in-house flight project. Today, however, those designs must meet the needs of a large array of flight projects. In fact, the Directorate is required to manage the operations of a large exploratory fleet of spacecraft that span the solar system - and beyond.

To fulfill this responsibility, it has become necessary to reexamine the entire set of mission system elements, i.e., functions, forms, and interfaces that characterize the workings of TMOD. We call this new combined system the "Deep Space Mission System." This system is much more than the Deep Space Network combined with the Advanced Multi-mission Operations System. Indeed, for space exploration, it represents a merging of

communications and information services that is analogous to recent industry trends in terrestrial applications. Customers will be able to obtain services that range all the way from communications links with their spacecraft to high levels of mission and science data processing.

The functions of the Deep Space Mission System are already migrating to a services-based approach. This approach, largely driven by the needs of the rapidly expanding customer base, will foster standardization, efficiency and ease of interface. The system will comprise the required networks and systems, placed anywhere in the Solar System, or beyond, to enable efficient communications and operation. Possible future examples may include navigation and relay satellites at Mars or elsewhere in the solar system. All flight and ground elements will fall within the bounds of this unified system. Processing will be performed on the ground or in space, according to the needs of each mission.



Deep Space Mission System

TMOD Goals

The core of the TMOD Implementation Plan is the set of **goals** that we will accomplish over the next 3 to 5 years. The five goals described herein are not intended to encompass every element of the TMOD program. Rather the intent is to identify a small set of key items that require special emphasis for the foreseeable future. In general, most or all elements of the TMOD Program can be logically viewed as contributing to one or more of these goals. Identified with each of the TMOD goals will be **metrics** that will enable us to mark progress toward its achievement in a quantitative manner. As is customary in any campaign targeting specified end states, a hierarchical procedure will be utilized. **Strategies** to advance toward the attainment of each goal will be identified. Each strategy will be decomposed into a set of specific **actions** that will be undertaken. Finally, to motivate near-term focus, the subset of these to be accomplished within the current fiscal year will be specified as the **FY98 objectives**.

The hierarchical components of each goal are described in the following pages. Here we simply articulate our goals for the FY98 planning cycle. We will:

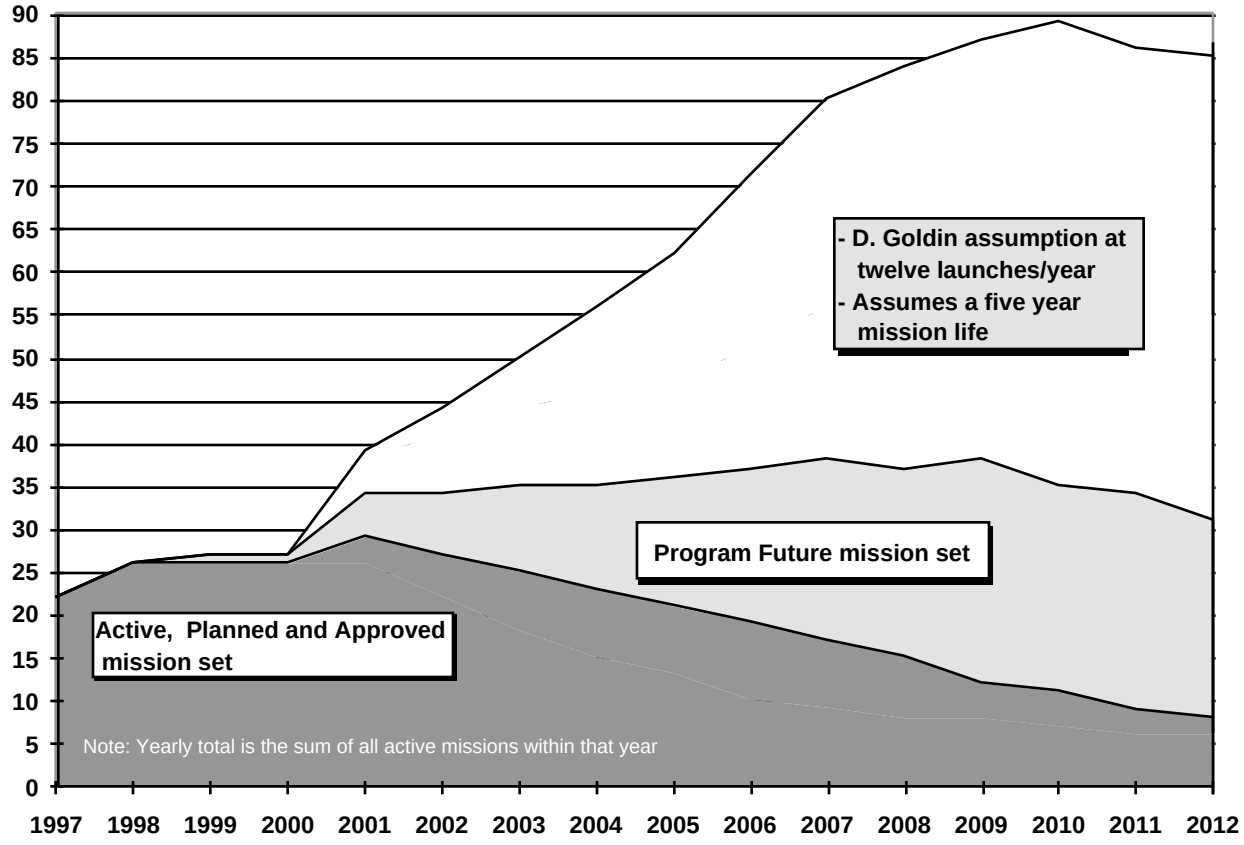
- **Increase data return capacity by 2.6x within 5 years.**
- **Accomplish a significant portion of our work through interaction with at least 10 strategic partners within 5 years.**
- **Improve TMOD's performance in capturing all of the data available from space missions.**
- **Complete the transition of TMOD into an organization that provides a full Mission Services System.**
- **Reinvest operations cost savings into technology and development that will yield further cost and performance improvement.**

GOAL #1: Data Return Capacity

Goal Statement: Increase data return capacity by 2.6x within 5 years.

Rationale:

Planning within the Space Science Enterprise has led to a transformation of the space science mission model from a few large spacecraft in the past to the many small ones in the future. Consequently, the Deep Space Mission System will require the capacity and capability to support 30 to 50 simultaneous robotic deep space missions. Additionally, eventual piloted missions to Mars, emanating from the Human Exploration and Development of Space Enterprise, must also be supported. Meeting these challenges will require an increase in capacity, which will be provided by whatever means most enhance system and network productivity. Though this may include construction of additional facilities, it is also likely to rely on technological leaps, such as migration to higher frequencies, or innovative operations procedures to provide the needed capacity.



Projected Mission Model
(Deep Space Missions and High-Earth Orbiters Only)

Metric:

- For each frequency band that TMOD supports, we define an aggregate communications capability which represents the sum of the downlink telemetry data rates that can be supported by each DSN aperture operating at that frequency, normalized to the case of a reference spacecraft at 5 AU (~Jupiter distance). For radio frequencies, this reference spacecraft radiates 10 W of output power through a 1-meter aperture, while for optical frequencies, the reference spacecraft transmits 3 W of output power through a 30 cm aperture. These correspond to typical RF and optical communications configurations being considered by future missions over the coming decade. Based on this definition, the DSN currently provides the following normalized communications capabilities:
    - S-band: 20 kb/s
    - X-band: 239 kb/s
    - Ka-band: 0 kb/s
    - Optical: 0 kb/s
- A network utilization metric measures the ratio of total DSN tracking hours allocated to flight projects and science relative to wall clock hours available in the network. It indicates what fraction of our tracking resource is allocated to customers and what fraction is spent on maintenance, failures, training, calibrations and inactivity due to unavailable periods.

Strategies:

- Improve antenna efficiency and reduce noise temperature.
- Implement Ka-band on DSN 34m and 70m antennas.
- Implement decoders supporting improved error correcting codes (e.g., Turbo codes).
- Align the plan for optical communications with the mission set and available resources.
- Increase our operational efficiency to support an increasing number of spacecraft.
- Develop capabilities to manage fleets of spacecraft.

Actions:

- Implement Ka-band on DSS25 (1998), DSS34 (2000), DSS54 (2001), DSS24 (2002), DSS26 (2003).
- Implement Ka-band on DSS15 (2004), DSS45 (2005), DSS65 (2006)
- Implement Ka-band on DSS14 (2007), DSS43 (2008), DSS63 (2009)
- Conduct a series of optical communications technology demonstrations.
- Provide the following normalized communications capabilities by 2003:
    - S-band: 24 kb/s
    - X-band: 309 kb/s
    - Ka-band: 348 kb/s
    - Optical: 4 kb/s

FY ’98 Objectives:

- Implement Ka-band on DSS25 by 04/01/98.
- Obtain funding commitment for Ka-band on DSS34, DSS54, DSS24, DSS26 by 03/20/98.
- Finalize Ka-band plan for DSS45, DSS65, DSS15 by 03/20/98.
- Finalize Ka-band plan for DSS14, DSS43, DSS63 by 03/20/98.
- Develop firm plans for optical communications technology demonstrations utilizing the STRV-II spacecraft, International Space Station and, perhaps, Space Shuttle by 03/20/98.
- Develop a plan for optical communications implementation and operations that is consistent with mission set needs and available resources by 10/01/98.

GOAL #2: Partnerships

Goal Statement: Accomplish a significant portion of our work through interaction with at least 10 strategic partners within 5 years.

Rationale:

TMOD must provide data and mission services to an ever expanding set of space exploration customers, perhaps as many as three times the current number within five years. During this time period, no significant budget growth is likely, with budget stability being the most optimistic outlook. At the same time, the Laboratory's business base will be expanding while its workforce is getting smaller. As JPL learns to perform more work with less employees, its spacecraft operations will have to be accomplished mostly out-of-house. In order to provide these services, TMOD will have to make use of contracts and partners. TMOD already performs most of its operations work through contracts. The major change for TMOD will be the use of true partnerships to accomplish the majority of its service provision.

The major partner for TMOD will be the winner of the Consolidated Space Operations Contract (CSOC). The CSOC winner, who will be selected during FY98-FY99, will provide operations at all of NASA's ground facilities. Since the CSOC will be a long term commercial provider of services, it will be driven to improve the systems it operates for NASA, thereby increasing its profits. This will create a true partnership environment with both TMOD and the CSOC striving for common goals. The CSOC contractor is expected to have the technical breadth and depth required to be a peer of JPL in these endeavors.

The infusion of new technology will enable TMOD to provide these new and increasing services at a reasonable cost. The TMOD technology program will likely grow in size and scope during the next five years. At the same time, however, the JPL workforce will not be growing. In order to continue to infuse technology, TMOD will have to seek partners in technology development. CSOC will likely be one of these. TMOD will also have to seek partners in very specialized technology areas - mostly at universities.

As the quantity of services increase, TMOD needs to seek out partners who can take on some of this work. Other space agencies are building assets that could potentially be used to provide TMOD services. In order to assure their successful use, TMOD must maintain long-term relationships with these agencies and develop standards for service provision. In some cases, TMOD will have to exchange technology with these other agencies.

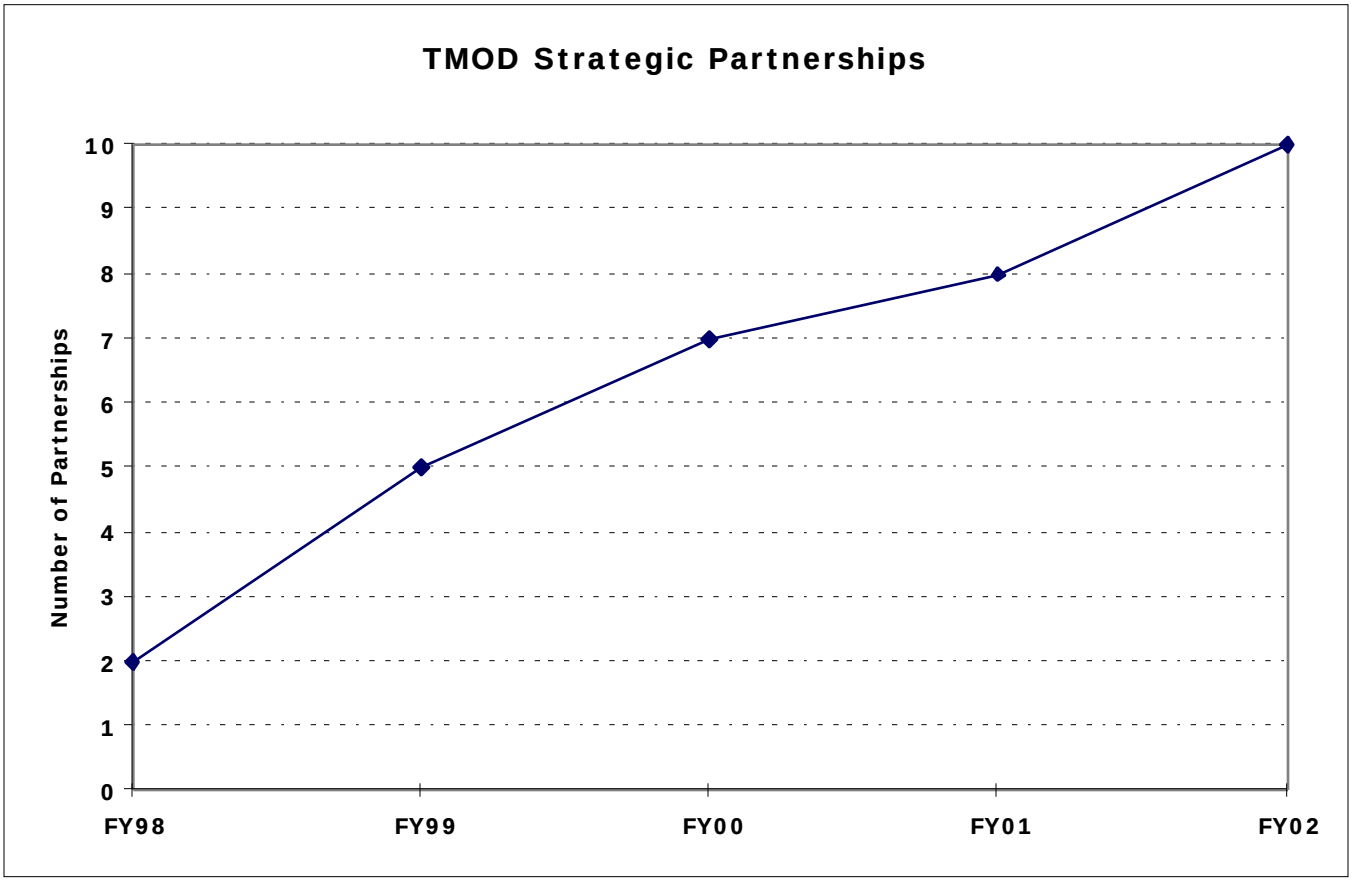
Metric:

A TMOD *Strategic Partner* is defined as an entity that has entered into an agreement with TMOD and satisfies the following conditions:

- A formal agreement of partnership is in place.
- Both TMOD and the partner make monetary investments in work of common interest.
- The products or services of both TMOD and the partner are improved as the result of the interaction between them.
- The interaction is sustained for at least two years.

The number of such strategic partnerships will be measured as an indicator of the breadth and depth of involvement of TMOD in partnerships.

TMOD will establish strategic partnerships as indicated by the following graph:



Strategies:

- Work towards a true partnership with the CSOC.
- Develop a technology partnership with Australia's Center for Space Industry and Research Organization (CSIRO).
- Set up TMOD centers of interest efforts at key American universities.
- Develop an extended network of global facilities for providing TMOD services.
- Provide the Level 2 Program Office for the NASA Space Mission Operations Standardization Program.

Actions:

- Align TMOD with the goals of the Apple Valley Science and Technology Center to engage students in the actual conduct of scientific experiments.

- Develop a process for sharing the results of CSOC internal improvements with other TMOD contractors - including the foreign DSN complexes. This is essential for maintaining a global set of facilities that will continue to provide services as a true network.
- Develop a process of sharing relevant technology results between TMOD and the CSOC.
- Set up a process for coordinating research performed through TMOD at JPL and in CSIRO's network of universities.
- Develop and exercise a mechanism for funding joint research at CSIRO facilities.
- Create an operations services center at a University. Allow that university to actually provide some TMOD services.
- Seek out universities with common technology and engineering interests to TMOD and set up long-term cooperative research programs.
- Lead a service standards program in partnership with all the world's major space agencies.
- Develop agreements with several foreign space agencies for cross support of services.

FY '98 Objectives:

- In conjunction with the Apple Valley Science and Technology Center, conduct scientific experiments, develop educational curricula and improve the usability of TMOD-operated facilities.
- Participate in the selection of the CSOC.
- Begin putting in place a process for technology sharing with the CSOC.
- Assess the capabilities of CSIRO to provide TMOD technology and integrate them into the FY99 technology program proposal process.
- Assess the existing TAP university partnerships for relevant TMOD research.
- Begin assessing American universities for future roles as TMOD research centers.
- Create a program office for management of the SOMO standards program.
- Create and lead NASA's Space Mission Operations Standardization Program Office: define the overall program of work; secure funding, and; orchestrate the Level-3 program implementation across the NASA Centers.

GOAL #3: Data Return Performance

Goal Statement: Improve TMOD's performance in capturing all of the data available from space missions.

Rationale:

Goal #1 refers to the capacity of the network to capture data. This goal relates to TMOD's performance against a given capacity.

For a given capacity, the amount of data captured is affected by the number and type of operator errors, by equipment reliability, and by software performance. Achieving this goal will drive improvement in these areas. (Note that reducing time required for pre-cals, for example, increases TMOD's capability and, is related to the capacity goal, not the performance goal. Achieving the pre-cals within the required time is a performance issue and does relate to this goal and the associated metric.)

Metric:

A telemetry capture metric will indicate the ratio of time that data, within agreed-upon specifications, were collected to the time scheduled for data collection.

Telemetry capture ratio = C/S, where

C = time that usable data were collected
(measured at the output of the Reed Solomon, or other appropriate, decoder)
S = time scheduled for collecting data
(as specified by the DSN schedule)

To avoid the measurement anomalies created by high-level averaging, this metric will be tabulated in two ways: on an aggregate basis, which includes all projects supported, and on a project-by-project basis. For the latter, projects receiving 93 - 100% of their data will be labeled "Green"; those receiving 84 - 93% of their data will be labeled "Yellow" and; those receiving < 84% of their data will be labeled "Red." R-Y-G Histograms will also be provided.

Strategies:

- Make investments that will improve the amount of data provided to our customers.
- Reduce number of operator errors which result in data loss.
- Improve hardware and software reliability in order to reduce the associated data loss.

Actions:

- Improve operations procedures.
- Improve documentation of procedures.
- Improve training.
- Standardize on operable hardware/software components.
- Reduce the number of legacy systems.
- Assess the failure history of hardware, software, and personnel to identify the principal contributors to data loss. Develop mechanisms for addressing the principal contributors.

- Establish the capability to obtain automated self-measurement of Quantity, Quality, Continuity and Latency (QQCL) by end of FY99.

FY ’98 Objectives:

- Establish a baseline for the “telemetry capture ratio” metric.
- Determine a goal which represents significant improvement over that baseline.
- Apply the recommended actions to meet the established goal.
- Finalize the plan for achieving automated self-measurement of Quantity, Quality, Continuity and Latency (QQCL).

GOAL #4: Services-Based Organization

Goal Statement: Complete the transition of TMOD into an organization that provides a full Mission Services System.

Rationale:

TMOD has already embarked on a path of transformation from what might be called a "discipline-based" organization to one that is "services-based." This transformation is motivated by the projection of rapid growth in the number of flight projects as well as in their telecommunications and mission operations requirements. Further, the dramatic reduction in their development cycle times necessitates a much more streamlined way in which the telecommunications and mission operations elements of a project can be assembled and operated. Thus TMOD will need to design, develop, procure, stockpile and manage the utilization of a family of standard flight and ground telecommunications and mission operations services and components. These will enable rapid mission development and plug-and-play compatibility.

TMOD will also offer a set of Mission Information System services including development of a complete Mission Operations System and end-to-end Mission Information System Engineering. Actual flight operations will be provided as appropriate, as well as use of operational systems to support the Integration and Test process for missions in the late stages of development. This transformation will result in a transparent interface with the user, a layered services model and an appropriate integration between flight and ground elements. Mission support activity will be characterized by an end-to-end approach. Analogous to trends in private industry, customers will perceive a merging of deep space telecommunications and information service provision. Accordingly, they will be assisted in the efficient use of the appropriate products and services.

Metric:

- Number of TMOD services available to flight projects.
- Number of missions utilizing TMOD services.
- Total number of services subscribed by the customer divided by the total number of services needed by the customer.
- Total level of services subscribed by the customer divided by the total level of services needed by the customer. (Note: "Levels" range from provision of tools to provision of end-to-end services.)

Strategies:

- Develop a new model for mission operations in partnership with SESPD and MED.
- Encourage common solutions for common needs.
- Demonstrate that NASA obtains a greater net return on Projects for which TMOD has MOS responsibility.
- Simplify the way in which customers communicate with and service their spacecraft.
  - Provide a transparent interface that is operable by scientists and project personnel.
  - Enable users to access their spacecraft from any location.
  - Evolve toward an Internet-based customer interface.

- Move from components/tools to services (within current “scope”).
- Extend mission operations service to on-board the spacecraft.

Actions:

- Consummate agreements with project Directorates for Mission Operations roles and interfaces.
- Establish the organizational structure and relationships within TMOD to execute the MOS role.
- Transition a first set of Projects in the design or development phase to TMOD MOS Service.
- Start all future (currently in A or pre-phase A) JPL Projects with TMOD providing the MOS.
- Develop an expanded set of services for use by flight projects.
- Develop efficiency metrics for service provision processes consistent with the results of the Activity-Based Costing effort.
- For each service offered to the customers, develop a metric which measures the quality of the service provided.

FY ’98 Objectives:

- Transition SIRTF, DS-1 and ICE and FIRE to TMOD MOS Service.
- Produce a TMOD MOS Charter.
- Create and document the process for MOS development and Mission Operations using the TMOD MOS Service.
- Establish the working interfaces for the SIRTF, DS-1, and ICE & FIRE MOS development; and, begin their execution.
- Develop a metric for, and then measure, the net increased return per NASA dollar in consolidating JPL MOS under the TMOD Directorate.
- Finalize the plan for implementing efficiency metrics for service provision processes.
- Define the metrics, and collect data, for the quality of services provided in FY98.

GOAL #5: Investment Mix

Goal Statement: Reinvest operations cost savings into technology and development that will yield further cost and performance improvement.

Rationale:

Decreasing budgets and life cycles for missions will make it less likely that they will be able to develop new technology. Consequently, TMOD will need to maintain an ongoing effort to identify, develop, demonstrate, and rapidly infuse new communications and operations technologies into the missions and their supporting network and services. The intent is to provide maximum availability of technology to Flight Projects and minimum end-to-end cost to NASA. Targeted investments in technologies uniquely driven by the demands of deep space missions will be combined with aggressive infusion of state-of-the-art commercial capabilities. The intent is to provide services at the highest performance-to-cost ratio and, where required, to provide new enabling capabilities. Increasing communications bandwidth requirements will be met by the use of higher radio, and even optical, frequencies. Space elements will utilize lower-cost and higher efficiency flight systems, including radios, amplifiers, antennas, compression, coding and, at certain destinations, in-situ links.

Commensurate with the decrease in mission size will be a decrease in mission life cycle time. Consequently, TMOD will need to provide rapid response to evolving customer requirements, by drastically decreasing the average development cycle time. This will be done by defining requirements closely with the aggregate customer base, being closely coupled with the ongoing technology pipeline, and utilizing state-of-the-practice engineering.

It is expected that any new initiatives will need to be balanced by savings in ongoing operations budgets. Consequently, TMOD will need to operate, maintain and sustain assets that are characterized by substantially lower costs, both recurring and non-recurring. Working closely with the Space Operations Management Office, TMOD will contribute to the success of the Consolidated Space Operations Contract, which will result in operations costs savings by integrating telecommunications and operations activities across the agency where common implementations can fulfill common needs. Deep Space Mission support will rely heavily on automation, with the goal of lowering mission operations costs wherever possible. Equipment will be simplified so as to improve maintainability.

Metric:

- Percentage of overall TMOD budget available for new technologies and developments
- “DSN Cost to Operate” measures the operational efficiency of the DSN by taking the ratio of its operations budget to the total number of tracking hours delivered. In essence it provides the dollars per tracking hour.
- Cost of MOS development (normalized).
- Cost of MOS operations (normalized).

Strategies:

- Reengineer our processes to dramatically reduce our operations, maintenance and sustaining costs.
- Use engineering practices that markedly reduce the life cycle of the development, test and sustaining processes.
- Develop automated and autonomous communications and mission operations components.
- Conduct mission operations with lower total workforce.
- Conduct mission operations with a higher percentage of non-JPL workforce.

Actions:

- Achieve workforce objectives of JPL Operations 2000 Plan.
- Achieve JPL/contractor ratio objectives of JPL Operations 2000 Plan.
- Streamline integration and testing of TMOD products and services.
- Combine configuration control and management processes, eliminating overlap and standardizing tools.
- Standardize acquisition and use of third party software.
- Develop standardized processes for authoring, reviewing and publishing documents.
- Integrate TMOD and DNP/VIVO efforts.
- Remove old equipment from the Deep Space Network.
- Simplify the structure of the DSN, separating deep space and near-Earth operations.
- Replace subsystems with simpler, commercial equivalents.
- Achieve operation-by-exception mission support, where human intervention is infrequently needed.
- Decommission DSS42 (Canberra 34m Standard) and DSS61 (Madrid 34m Standard) by 12/31/98

FY ’98 Objectives:

- Achieve the JPL Operations 2000 Plan FY98 workforce target by 10/01/98.
- Achieve the JPL Operations 2000 Plan FY98 JPL/contractor ratio target by 10/01/98.
- Following decommissioning of DSS17 (Goldstone 9m), use it as a testbed for automation of the 26m subnet by the end of FY99.
- Complete first delivery of the Network Control Project (NCP) by 06/01/98, laying the foundation for network automation.
- Remove 50 racks of old equipment from the Deep Space Network complexes.

Alignment

	TMOD Goal #1	TMOD Goal #2	TMOD Goal #3	TMOD Goal #4	TMOD Goal #5
	Data Return Capacity	**Partnerships**	**Data Return Performance**	**Services-Based Organization**	**Investment Mix**
	Increase data return capacity by 2.6x within 5 years	Accomplish a significant portion of our work through interaction with a least 10 strategic partners within 5 years	Improve TMOD's performance in capturing all of the data available from space missions	Complete the transition of TMOD into an organization that provides a full Mission Services System	Reinvest operations cost savings into technology and development that will yield further cost and performance improvement
JPL Strategies					
Do what no one has done before	HIGH		MEDIUM	MEDIUM	HIGH
Fly small, frequent, low-cost missions	HIGH		HIGH	HIGH	HIGH
Combine JPL's strengths with those of other partners		HIGH			
Serve as a scientific bridge between NASA and other government agencies		HIGH			
Infuse and transfer new technology	HIGH	HIGH	MEDIUM		HIGH
Nurture our capability	HIGH	MEDIUM	HIGH	HIGH	HIGH
Continually improve all our work processes	MEDIUM	MEDIUM	HIGH	HIGH	HIGH
Inspire the public with the wonder of space science		MEDIUM			
Invest in employee learning and growth				MEDIUM	
Be a socially responsible organization		MEDIUM			
JPL Change Goals					
Technology	HIGH	MEDIUM	MEDIUM		HIGH
Partnering		HIGH			
Employee				MEDIUM	
Best Business Practices		MEDIUM		MEDIUM	
Core Business Implementation		MEDIUM		HIGH	MEDIUM

References

1) "National Space Policy," 1996
   - Available at: http://www.whitehouse.gov/WH/EOP/OSTP/NSTC/html/fs/fs-5.html

2) "NASA Strategic Management Handbook," (NASA Procedures and Guidelines 1000.2)
   - Available at: http://www.hq.nasa.gov/office/codez/plans.html

3) "NASA Strategic Plan," NASA Policy Directive (NPD)-1000.1
   - Available at: http://www.hq.nasa.gov/office/nsp/NSPTOC.html

4) "Space Science Strategic Enterprise Plan,"
   - Available at: http://www.hq.nasa.gov/office/strategy/1997/

5) "Space Operations Implementation Plan – Draft E," Space Operations Management Office, NASA JSC, August 1997

6) "The JPL Strategic Management Process Plan," October 1, 1996

7) "The JPL Implementation Plan, Fiscal Year 1998," (JPL 400-549), October 1, 1997